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三次元プラズマ発光分布の一方向からの推定
Estimation of three-dimensional emissivity profile from one direction

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Three-dimensional (3D) information not only for plasma itself but also for plasma faced material and levitating particles are important for a wide range of plasma research fields. Recent progresses have shown the importance of helically deformed configurations and 3D mode structures in high temperature plasmas [1]. 3D information about the positions of fine particles in a plasma is important for plasma processings as well as for studying physical processes in Coulomb crystals [2]. Among the various devices, separated two or more detectors with computed tomography are widely used to determine the 3D information. However, many experimental devices are faced with a limitation of the number of viewing ports and viewing areas. It is required that a method distinguishing 3D structure of plasma from a certain image obtained from one viewing port.

To obtain 3D structure of plasma from one direction, we are developing two methods Basic idea is using multi lens or multi-pinhole camera. In reconstruction phase, there are two approaches. One is integral photography [3] and Lucy-Richardson deconvolution (LRD) techniques [4, 5]. Another is basis expansion.

First, we have developed 3D imaging system for plasma with integral photography and LRD techniques [6]. Developed 3D imaging system has been applied surface wave plasma to obtain 3D emissivity distribution. In fig. 1, reconstructed emissivity distribution is superimposed on a schematic of experimental configuration. Preliminary result suggests that plasma emission is localized around the powered antenna of microwave. Elongation or reconstructed emissivity along optical axis would be artifact due to LRD.

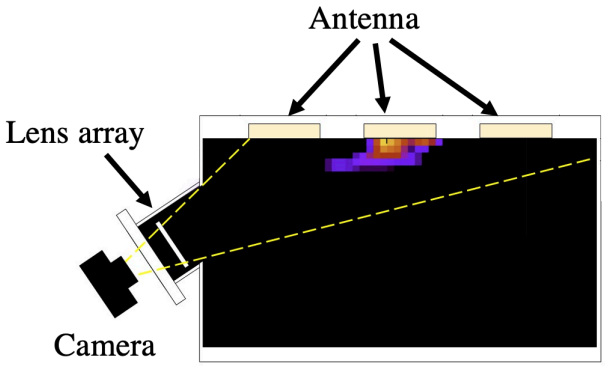

Fig. 1: Example of reconstructed emissivity distribution.

Another technique, basis expansion has been applied to Reversed field pinch (RFP) plasma [7]. Developed system is conducted with multi-pinhole disk and micro channel plate. Projected intensity of soft X-ray is expressed as convolution between emissivity and projection matrix. We apply basis expansion with suitable orthogonal functions to emissivity. Then, projected image is also expressed as summation of basis patterns. From the result of 2D basis expansion, we can estimate 3D emissivity profile.

References

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